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I	3 numbers,	1928	VII	1 number,	1934
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III	3 ,,	1930	IX	4 ,,	1938
IV	4 ,,	1931	X	4 ,,	1939
V	2 ,,	1932	XI	4 ,,	1940
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ISSUES OF THE AGRICULTURAL CIRCULAR.

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Vol. 1, 1920, 12 numbers.
,, 2, 1921, 5 ,,
,, 3, 1922, 4 ,,
Vol. 4, 1923, 1 number.
,, 5, 1924–5, 2 numbers.

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3. Rhinoceros Beetle in Samoa, 1912.
4. The Banana in Fiji, 1912.
5. Scale Insect on Bananas, 1913.
6. Lemon Grass, 1913.
7. A Mission to Java for a Coleopterous Pest of Bananas, 1914.
8. Coconut Experiments, 1915.
9. Soils of Fiji—I., 1916.
10. Fijian Plant Names, 1918.
11. Alluvial Soils of Fiji, 1919.
12. Leaf Moth of Coconuts, 1919.
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14. Transparent Coconut Scale, 1921.
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—EDITOR.

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AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 13.] SEPTEMBER, 1942. [No. 3.

EDITORIAL.

WE welcome our new Governor, Sir Philip Mitchell, K.C.M.G., M.C., who has spent most of his official career in East Africa and comes to Fiji with a high reputation as an administrator of long experience, especially in native affairs.

In his opening speech to the Legislative Council on the 12th August amongst other statements of much movement at this time, His Excellency emphasized the national importance of farming when he said that " There is little doubt that farming and skilled labour are amongst the most important " forms of work.

Later in talking of the new war organization in the Colony he said " our object should be to produce crops and timber and everything else which we can produce for the whole of the population and the armed forces . . so that not one ton of shipping nor the life of one sailor shall be needlessly imperilled to bring to us the necessities of life."

His Excellency's encouraging statements should stimulate producers to still greater effort than has been made hitherto towards the achievement of a fuller measure of self-sufficiency in all things that can be produced in the Colony, especially in the matter of foodstuffs necessary to maintain the life of the people in reasonable health. The Department of Agriculture already supplies weekly 60 tons of vegetables and fruit to the military forces and has materially increased the production of food for the civil population in various ways but there is still much room for the expansion of food production especially in green vegetables, beans, rice and potatoes (or potato substitutes), pork and fish. Farmers are therefore urged to co-operate in our additional efforts which are about to be launched, including the registration of growers in certain areas and the guarantee of markets for all their crops. Substantial quantities of vegetable seeds have recently been distributed to growers and it is anticipated that a considerable increase in production will soon be apparent, provided that anything like normal weather prevails.

This issue of the *Journal* contains the concluding portion of Mr. Parham's useful article on various plants of these islands, which started in the June number with food plants, green vegetables and fruits. This second part, which should prove of much interest, deals with forest products such as timber, fuel, fibres, rafts, etc., poisonous plants, first-aid plants and cover

crops. Reference should be made to the *Journal* for December 1937 (Vol. 8, No. 4) for further details of plants used in the native practice of " draunikau ".

The continued spread of the green vegetable bug is disconcerting as it was only in October last that it was reported from Taveuni and Rabi. Latest records show it has now reached Kanacea, Naitauba and Mago in northern Lau and can be expected to occur as well in Vanuabalavu Island. The Egyptian egg parasite *Microphanurus* is already established in parts of the Suva district and hopes are held of controlling this bug especially if fresh egg-rafts are sent to the Entomologist for parasitisation and liberation on the sender's own property.

Although the Solomon Islands are undergoing the full horrors of war it seems likely that the giant toad, introduced there in 1940, will become established ultimately with desirable results to the coconut plantations where insect pests will have had uninterrupted opportunities to increase.

Now that supplies of derris are no longer available for the Allies from Malaya, it is all the more important that consideration be given to production of this insecticide in other countries. The species *elliptica* has been grown in Fiji for several years but only recently have pests been found in the stored roots. The whole question of local production, milling, application and insect control is under way and a short article on the last named aspect is given in this issue.

The chemical analysis of a soil often yields valuable information respecting the sufficiency of plant food and the need or otherwise of fertilizer treatment. With classical methods of soil analysis, particularly in the general laboratory, the number of samples that can be examined is limited on the score of the time required and the costs in chemicals. In recent years a great deal of attention has been directed to what has been called rapid soil methods using michrochemical and semi-microchemical techniques. In the paper " Observations of Soil Methods, Part II," the authors examine certain of the methods concerned with the estimation of phosphates and potash and develop a technique suitable for Fiji soils.

A practical note on poultry feeding in wartime by the Senior Veterinary Officer is included in this issue. It should provide sufficient guidance to the poultry keeper to enable him to succeed in establishing an economic flock and also prove interesting reading.

An article on twenty-nine varieties of rice grown in Fiji is interesting as showing the quite unnecessary bestowal of different names on the same variety. Such factors as maturation, yield per acre, milling percentage, flavour and cooking characters are all dealt with and further experiments, which it is hoped will be carried out next year, should give even more interesting information on this important food crop.

In the editorial for September 1940, attention was drawn to the danger of unwanted insects, particularly malarial mosquitoes, entering this Colony by plane. This question is even more important now as aerial communication in the Pacific is notoriously being developed during the more active phase in this area. This danger of unwanted insects, which would not recognize the cessation of hostilities, is equally applicable to the various plant pests from Melanesia which were given in some detail in the *Journal* for last December. It is therefore encouraging to learn that consideration is being given to checking the entry of any such undesirable insects, which once established on the larger islands, would be difficult and costly to eradicate apart from the harm they would do to the population.

SOME USEFUL PLANTS OF THE FIJI ISLANDS.

By
B. E. V. PARHAM, M.A.
Agricultural Officer (Plant Pathology).

(*Concluded.*)

PART II.

II.—FOREST PRODUCTS.

Brief reference is made here to timbers and certain other forest products, information concerning which has been called for in recent months. Within the limits of space it is possible to list many of these by name only.

1. Timber.

The Fiji forests are not extensive nor highly productive of large trees capable of conversion into timber. With one or two exceptions much accessible forest land has been cut over more than once and most of the best timber trees removed.

Pole timbers are characteristically wanting as also is good hardwood for general purposes.

Supplies of posts for fencing and rough construction work are lacking in many areas; and necessity often demands the substitution of inferior species for much work of a temporary or semi-permanent nature.

(1) *Softwoods.*

The principal softwoods available are:—*Agathis vitiensis* Drake "DAKUA" or Fiji kauri, *Podocarpus vitiensis* Seem. "DAKUASALUSALU", *P. javanicus* (Burm) Merr. "AMUNU" or "KAUTABUA", *Dacrydium elatum* Wall. "YAKA." The Brown Pine (*Podocarpus elatus*), native name "KUASI" and other Podocarps occur but are of small size and little importance.

All these species are found at medium elevations in the larger islands.

(2) *Hardwoods.*

The principal hardwoods are:—

Calophyllum burmanii	"DAMANU."
Sideroxylon sp.	"SACAU."
Storckiella vitiensis	"QADI."
Eugenia spp.	"YASI."
Endospermum macrophyllum	"KAUVULA" or "LEKUTU."
E. robbieanum (Vanua Levu)	"VULAVULA."
Intsia bijuga	"VESI."
Vitex vitiensis	"ROSAWA."

of these "kauvula" and "vulavula" are of poor quality suited for case timber only.

(3) *Poles and Posts for Building, Fencing, etc.*

The most durable hardwoods in this category are "BUABUA" (*Guettarda speciosa*) and "CEVUA" (*Vavæa amicorum*); but these are now mainly obtainable in Vanua Levu and Kadavu only.

Other species of superior quality and durability in contact with the ground are (*Eugenia* spp.) "YASI"; (*Garcinia sessilis*) "LAUBU"; (*Premna taitensis*) "YARO"; (*Astronia robusta*) "TAVOTAVO"; (*Bischoffia javanicus*) "KOKA"; (*Carapa moluccensis*) "DABI" and (*Bruguiera gymnorhiza*) "DOGO."

Also vesi, sacau and qadi are very durable in contact with the ground and old mature coconut stems will last four to five years in the same position.

Live fences, etc.—Certain species grow spontaneously when used as posts and form useful live fences, hedges or windbreaks. Of native species the most used are "VAU" (*Hibiscus tiliaceus*), "YARO" (*Premna taitensis*), "DRALA" (*Erythrina indica*) and "VUTU WAI" (*Barringtonia racemosa*). The last is particularly useful for fencing on wet swampy places.

Of introduced species—the best are *Gliricidia sepia*, rain tree (*Albizzia* spp. and *Pithecelobium saman*), banidakai (*Jatropha curcas*) and "VAIVAI" (*Leucæna glauca*). These are all of rapid and free growth.

Useful for general construction above ground and under cover from the weather are *Causarina equisetifolia* "NOKONOKO"; *C. nodiflora*, "VELAU"; *Parinarium laurinum* "MAKITA"; *Rhizophora* sp. "TIRI"; *Trichospermum richii*, "MAKO".

Valuable for certain purposes are the small palm "BALAKA" (*Balaka seemanii*) and the much larger "NIUSAWA" or "SAQIWA" (*Veitchia joannis*); split lengths of which can be used for many purposes. Old stems of the tree-fern "BALABALA" (*Cyathea lunulata*) are extremely durable and resistant to fire.

2. Fuel and Firewood, etc.

The most important firewood supply is that provided by the mangroves (*Bruguiera* and *Rhizophora* spp.).

Other good firewood species are "DAWA" (*Pometia pinnata*), "DOI" (*Alphitonia excelsa*), "NOKONOKO" (*Casuarina equisetifolia*), "SA" (*Parinarium insularum*), "NUQANUQA" (*Nelitris suffruticosa*), "VUGA" (*Metrosideros polymorpha*) resembling New Zealand "RATA," "WASE" (*Dodonæa viscosa*) in the dry zone; *Citrus* spp. (Lemon, shaddock, etc.) "SAMA" (*Commersonia echinata*), "DROU" (*Trema* spp.), "VAU" (*Hibiscus tiliaceus*) "QUAVA" (*Psidium guajava*) especially in dry zone, and "IVI" (*Inocarpus edulis*). All these are excellent for open fires—and guava, "nokonoko" and "dawa" make first class charcoal—as does also the shell of the coconut.

3. Fibres, Ties and Fastenings.

Many valuable ties are available. Those in most common use are listed below.

"WA MIDRI" (*Stenochlæna palustris*)—high climbing fern with tough wiry stems, commonly used for frame ties in native buildings.

"WA ME" (*Freycinetia storckii*)—the aerial roots of this epiphyte are very tough and strong.

"WA ULO" or "GALOA" (Vanua Levu) (*Flagellaria indica*) one of the rattan canes, climbing by means of the tendril-like extension of the midribs. Extremely strong.

"WA KATA" (*Flagellaria* sp.)—a smaller species than "WA ULO," more flexible.

"WA VERE" (*Flagellaria* sp.)—a very small slender climbing cane of considerable length and strength.

"QANUA" a climbing palm with whip-like extension of the main leaf rachis, armed with hooks. Valuable for basket work, etc.

"VAU" a tree—the bark of young straight stems being widely used for a great number of purposes.

"WAYAKA" (*Pachyrhizus erosus*)—A large climber in open country—with hairy trilobate leaves and a tough stem of considerable length.

" QATIMA " (*Urena lobata*, Fam. *Malvaceæ*)—A tall shrubby plant of open country, with large soft leaves and small pink hibiscus-like flowers. The bark furnishes an excellent fibre similar to " VAU."

" WALAI " or " WATAQIRI " (*Entada scandens*)—an extremely large liane with stems often more than 12 inches in diameter. The stems are beaten with a mallet and split into lengths, or the smaller stems are used whole for a number of purposes such as house fastenings, raft lashings and tow-ropes, etc. The stem contains a quantity of potable sap which in the ridge forest is often used as a drink in the absence of water.

" VIA " (*Cyrtosperma edulis*)—an aroid, and " VUDI " (bananas and plantains)—the mature stems provide a very strong binding fibre, the former being commonly used in Rewa for house fastenings.

" MAGIMAGI " or sinnet, made by plaiting the fibres of the coconut husks was formerly an important article of trade and is the best of all fastenings for both indoor and outdoor purposes.

4. LOCAL BUILDING MATERIAL.

In addition to the plants mentioned in the preceding paragraph which are also used in the construction of buildings, considerable use may be made of the following—

Bamboos—(" BITU ") especially the native species, are excellent for a number of purposes being very light, straight and strong. Split bamboos have many uses and when plaited make useful walls and floors for buildings. Split bamboos can also be used for reinforcing concrete.

Reeds (" GASAU ") find a number of uses in native house construction—both for lining of walls and for fastening thatch. Reed tops are also used for thatching roof and walls.

There are many good thatching materials available—as sago palm leaf (" SOGA "), reed tops, " duruka " leaves, cane leaves and several grasses, both the indigenous species " CODINA " (*Paspalum orbiculare*) and " GI " (*Imperata cylindrica*) and the introduced Vetiver grass (*Vetiveria zizanoides*) being most useful.

Near the coast, the large sedge " VULUVULU " (*Scirpodendron costatum* and the leaves of *Pandanus* (" BALAWA ") are also used.

For outer thatching on walls the best material is " MAKITA," while mango leaves and those of the swamp fern " BORETI " are also frequently used where makita is not obtainable.

For temporary shelters, the leaves of the coconut and in the forest the banana-like leaves of the " VAVA," a species of *Heliconia* provide a water-tight covering with a minimum of labour.

5. RAFTS, ETC.

The best rafts are made from bamboos lashed together with the lianes " WALAI " or " VAU," etc., and braced by cross sticks fitted through the bamboos. A single bamboo is of great assistance for an individual crossing of a deep stream.

The stems of bananas spiked together by cross sticks make a buoyant float.

The light timbers suitable for dug-outs, etc., are " MAKO," " MAKOSOI." " DAKUA " and " UTO " (Breadfruit).

III.—POISONOUS PLANTS.

There are not many plants which are likely to cause trouble on account of their poisonous properties.

The most important are: "SINU" (*Excœcaria agallocha*) a seaside tree with glossy foliage—which exudes on being cut a copious white sap or latex. This sap causes a severe skin irritation and is reputed to cause blindness if it enters the eyes. The tree is known in Queensland as "blind eye" or white mangrove.

Another plant exuding an irritant sap is the "KAUKARO" or "itch wood" —*Oncocarpus vitiensis*, a medium-sized tree frequently growing along streams inland. The leaves are dark green—resembling in shape those of a chestnut, and the fruit is a black nut with a bright red aril. On exposure to the air, the sap turns black and this exudate is often seen on the trunks of this species. The most intense irritation of the skin follows contact with the juice of this tree which is plentiful under the bark, and may last for several weeks. As the tree forms useful looking straight saplings it is often cut with unpleasant results by persons ignorant of its properties.

The tree nettle (*Laportea harveyi*) is fortunately not very common, it is readily recognized by its large hairy leaves, contact with which causes slight skin irritation.

A recent case of sickness arising from the eating of unknown fruits by two men new to the Colony was traced to the physic nut (*Jatropha curcas* L.) known to the Fijians as "BANIDAKAI" or "WIRIWIRI" and very common in Nadi Province and elsewhere. The seeds contain a toxalbumin, curcin which is an irritant poison and should not be eaten.

The nuts of the candlenut (*Aleurites moluccana*) Native name "LAUCI" or "SIKECI"; the fruits of "VASA" or "REWA" (*Cerbera odollam*) and of "VUTURAKARAKA" (*Barringtonia racemosa*) are not edible and should be avoided.

Among introduced plants the most dangerous are oleander (*Nerium oleander*) and the yellow oleander (*Thevetia neriifolia*) which contain a poisonous glucoside, thevetin, affecting the action of the heart.

Of probable poisonous character are also the native trees "DUVA KALOU" (*Pittosporum arboreum*), "MANAIVANUA" (*Excœcaria acuminata*) and the seaside creeper "WA DUVA" (*Derris uliginosa*) the toxic principal of which, rotenone, renders it a useful insecticide and fish poison. Fresh water extract is effective for control of dog fleas, etc.

The red and black seeds of the black-eyed susan—"LERADAMU"—(*Abrus precatorius*) a small vine, contain a toxalbumin, abrin, which is a blood poison, and ineffective when taken internally.(5)

IV.—FIRST AID PLANTS.

In the absence of completed investigations into the value of local plants of reputed medicinal value, reference is limited to a few plants which by experience have proved useful for external application in the absence of other aids.

The juice expressed from the leaves of the mile-a-minute (*Mikania scandens*) native name "WA BOSUCU," is a useful antidote for the sting of a hornet or bee.

The leaves of "KURA" (*Morinda citrifolia*) and "DANIDANI" (*Panax fruticosum*) are heated over a fire and used as a bandage for boils and other sores or wounds with good effects.

The leaves of the candelabra bush (*Herpetica alata*)—an introduced shrub with conspicuous yellow flowers on erect panicles—contain chrysophanic acid and are used for the treatment of skin infections—ring worm, "Dhobie itch," etc.

"QIQILA" (*Micromelum minutum*) a shrub with small dotted leaves is used as an antiseptic for cuts and wounds. The juice is extracted by pounding in a small bamboo mortar.

The sphagnum moss (*Sphagnum cuspidatum*)—Native name "TUAIDA" has many uses and makes useful stuffing for pillows, etc.

A very large number of reputedly valuable medicinal plants has been listed: but their theurapetic value has not been determined and they are therefore of no practical concern to the present article.

V.—COVER PLANTS.

Under this heading are included such plants which on account of their rapid growth are useful for forming cover on open ground, earth-works and for camouflage.

1. Turf Grasses.

Much time has been spent in the search for suitable grasses for greens, lawns and aerodromes.

It is essential that such grasses should tolerate local conditions of climate and compete satisfactorily with existing species.

In the wet zone, despite great care with drainage, it has been found that such grasses as couch (*Cynodon dactylon*), *Paspalum dilatatum* or *Digitaria longiflora* cannot maintain a good cover owing to the high rainfall during the summer months. They are soon replaced by such species as seed grass (*Chrysopogon aciculatus*), broad-leaf carpet grass (*Axonopus compressus*) and sour grass (*Paspalum conjugatum*).

It is therefore considered that in wet areas the first two in the latter group together with the narrow-leaved carpet grass (*Axonopus affinis*) are the most suitable species for turf and greens.

The creeping tick-trefoil (*Desmodium triflorum* and other species) is an essential element in healthy turf.

In the dry zone, couch grass (*Cynodon dactylon*), *Digitaria longiflora* and *Chrysopogon aciculatus* are probably most likely to succeed: and Thurston grass (*Brachiaria mutica*) is useful.

For binding ditch banks, bunds of rice fields and irrigation works Vetiver grass is most useful: and for contour hedges to control erosion this plant, Guinea grass (*Panicum maximum*) and Vasey grass (*Paspalum urvillei*) are most effective.

2. Plants for Camouflage Purposes.

The following are listed as probably the most useful for the purpose, having regard to the necessity of assuring rapid cover in varying situations and the desirability of using such plants as will not be noticeably different in colour or appearance from the surrounding vegetation. For these reasons preference is given to indigenous or well-established naturalized species. The plants recommended are grouped for the situations in which they are most likely to be needed. A natural mixture of species would be advisable rather than a pure stand of any one species.

(1) *Creepers for sandy beaches.*

Such situations are often exposed to sea winds and spray where only a few species can survive. These are:—

"Lawere" (*Ipomœa pes-caprœ*)—a far spreading prostrate creeper and sand binder with stems over 30 feet long. Propagated by seeds and cuttings.

"Drautolu" (*Vigna marina*)—the beach pea, a strong growing prostrate creeper forming dense cover. *Canavalia obtusifolia* is known by the same name and would serve the same purpose.

"Wa Duva" (*Derris uliginosa*)—a prostrate rooting creeper or high-climbing vine.

The stoloniferous grasses of robust growth near the sea are St. Augustine's grass (*Stenotaphrum americanum*), *Digitaria longiflora* and *Thuarea sarmentosa*. These quickly form a close mat of creeping stems.

(2) *Creepers for Littoral or inland situations.*

Behind the beach proper a number of plants flourish that are well adapted for the purpose in mind. These are:—

"Wa Bosucu" (*Mikania scandens*)—"mile-a-minute," a rapid growing succulent far-spreading climber—propagated by seeds or cuttings.

"Walai" (*Entada scandens*)—a giant creeper and climber—grown easily from seed.

"Wakaya" (*Pachyrrhiyus erosus*)—the yam-bean.

"Waduva" (*Derris* spp.) including the introduced *D. elliptica*.

"Wavuti" and "wa bula" (*Ipomœa* spp.)—large rapid growing climbers of the *Convolvulus* family. Among naturalized plants the most promising are: *Calopogonium muconoides*, *Desmodium triflorum*, *Passiflora fœtida*, the Kumala as well as rice bean, Mauritius bean, cowpea and the so-called peanut grass of the dry zone sandhills.

These are prostrate creepers of rapid growth, which are especially good on account of their foliage colour and which maintain and spread themselves by prolific seed production or by means of rooting runners.

(3) *Shrubs.*

These are selected on account of their tolerance of a wide range of conditions, their ease of propagation and rapid growth.

Some are invaluable for wind breaks and hedges. They are as follows:—

"Vaivai" (*Leucœna glauca*)—a shrub with fine foliage which may be grown from stake cuttings or seeds.

Gliricidia sepia or "madre de cacao"—of rapid growth from cuttings or stakes—is excellent for hedges and windbreaks.

Herpetica alata and the Mexican Sunflower (*Tithonia diversifolia*) as well as the shrubby species of *Crotolaria* are very easy to establish and of rapid, spreading growth.

The indigenous shrubs known as "KAUNIYALEWA" (*Sophora tomentosa* and *Messerschimidia argentea*) are extremely well adapted to exposed sea coast habitats, and their grey-green foliage might be an added advantage in certain situations.

(4) *Camouflage Nets.*

Natural materials for the making of camouflage nets are readily available as the bark of "VAU" and "QATIMA" (*Urena lobata*), the stems of "WAYAKA" and "WAMIDRI," and "MAGIMAGI."

The fibrous sheath from about the coconut spathe is useful as garnishing.

VI. REFERENCES

(1) Joachim, A. W. R. 1938.—"The Analysis of Ceylon Food Stuffs"—*Trop. Agric.* Vol. XC, No. 1.
(2) Rosedale, J. L. and Milsum, J. N. 1940.—"Malay leaf and other Vegetables and their Analysis"—Dept. of Agric. *S.S.* and *F.M.S. Bull.* 31.
(3) Blackie, W. J. 1940.—"Vitamin C. Values of Fijian Fruits"—Fiji *Agric. Jour.* Vol. 11, No. 1.
(4) Goldberg and Levy, L. 1941.—"Vitamin C. content of Fresh Canned and Dried Guavas"—*Nature*, Vol. 148, Sept.
(5) Raymond, W. D. & sl. 1941.—"Nutritive value of some Tanganyika Foods"—E. Af. *Agric. Jour.*, Vol. 6, No. 3.
(6) Dalziel, J. M. 1937.—"The Useful Plants of West Tropical Africa"—London.

SUVA VEGETABLE PRICES.

As a number of complaints have been made about the difficulty and expense of vegetables and fruit in Suva, a survey was recently made of the main shopping centres by a reliable person who was not a civil servant.

The following are the average prices in Suva now (September, 1942):—

China cabbage	3d. per bunch.	Kumalas	1d. per lb.
English cabbage	8d. 9d. per lb.	Pumpkin	1d.–2d. per lb.
Lettuce	9d.–1s. per doz.	Tomatoes	6d.–9d. per lb.
Dwarf beans	6d. per lb.	Cucumber	2d.–4d. each.
Butter beans	3d.–6d. per lb.	Egg plant	1d. each.
Spring onions	2d.–3d. bunch.	Papaya	3d.–4d. each.
Dalo	1d. per lb.	Lemons	6d. per doz.
Carrots	3d. per bunch.	Grenadillas	3d.–4d. each.

In view of the seasonal difficulties experienced this year, the shortage of seed, the heavy demands from the armed forces and transport difficulties, the above prices appear to be reasonable.

Should higher prices be demanded, this Department would be grateful for reliable information including the name of the store, when inquiries will be made.

Owing to the heavy demands for foodstuffs for increasing labour forces as well as for the armed forces, all persons are urged to grow at least some vegetables for themselves and particularly sweet potatoes and tapioca since supplies of Irish potatoes will be very difficult to procure during the next six months.

H. W. JACK,
Director of Agriculture.

POULTRY FEEDING IN WARTIME.

By
C. R. TURBET, M.R.C.V.S., B.V.Sc.
Senior Veterinary Officer.

Owing to wartime conditions and the difficulty of obtaining foodstuffs from overseas, it is necessary to revise our ideas in regard to poultry feeding so that the best use may be made of those foodstuffs which may be obtained within the Colony.

General Principles of Feeding.

To understand correctly the principles of feeding it is well to know something of the chemical make-up of foodstuffs.

(*a*) *Protein* is that part of the food which is rich in nitrogen and it is from protein that the soft tissues of the body are mostly built up. Protein is derived from both foods of animal and vegetable origin. The quality of protein varies and as a general rule those derived from animal tissues are superior. Examples of protein rich foods are meat meal, fish meal, and milk, whilst among the vegetable foods, coconut meal, pumpkin, all beans and peas, and fresh young grass are examples.

(*b*) *Carbohydrates.*—The sugars and starches are the principal foods in this group, and it is from these foods that energy is derived. Excess is stored as fat.

(*c*) *Fat.*—This is also an energy producing food rich in vitamins and health giving qualities when fed in limited quantities.

(*d*) *Minerals* in food are necessary not only for construction of the bony framework of the body but also since they enter into the composition of blood and the soft tissues of the body.

(*e*) *Water.*—An abundant supply of fresh water should be provided so that the birds may maintain the correct equilibrium or body fluid.

(*f*) *Vitamins.*—These are complex chemical substances contained in many foods and their presence is necessary for the maintenance of health, growth, and production.

To obtain the best results in the feeding of poultry, as with other animals, the foods mentioned above should occur in the correct proportion, so that all are utilized to the best advantage without waste.

The proportion in which these components occur in food is referred to as the nutritive ratio. The desired ratio varies according to the age of the bird and according to whether one is feeding for growth, egg production or fattening. The nutritive ratio NR is as follows:—

$$NR = \frac{CH + (F \times 2{\cdot}25)}{P}$$

CH = Carbohydrate; F = Fat; P = Protein.

Owing, however, to the difficulty of at present obtaining all foodstuffs which might be recommended in any formula for a food mixture, it is not desirable to pay very great attention to attempting to mix a food absolutely correct as to its nutritive ratio and from a practical point of view it will be sufficient if one attempts to use intelligently the available foodstuffs so that the nutritive ratio is maintained as closely as possible. In other words, one should consider whether or not sufficient protein, particularly that of animal origin, is being given in the ration.

Apart from the chemical composition of the food one has also to consider palatability and digestibility. In regard to palatability one is able to

obtain a fair idea as to whether it will be suitable for poultry food by its smell. The food may also be tasted. Fresh, sweet-smelling food without bitterness will usually be palatable to poultry. When food is changed birds may refuse the new food in spite of it being normally of good taste and palatable. As soon, however, as they become accustomed to the characteristic flavour of the new food they will usually take it readily.

Digestibility depends upon the amount and nature of the fibre content of the food, for instance the fibre content of maize is such as to allow very good digestion of the whole of the grain whereas in the case of padi the hull is almost completely indigestible owing to the large proportion of silica in the hull.

The Digestive System.

When swallowed, food proceeds down the gullet and is received into a loose sack-like dilatation of the gullet known as the crop. This can readily be seen or felt, when full, at the lower part of the neck. In this organ a certain amount of pre-digestion or softening takes place through the agency of the juices secreted from the wall of the crop. The process is therefore similar to that which takes place in the paunch of the cow. From the crop the food again enters the gullet and passes to another dilatation of the gullet known as the proventriculus, where a more advanced stage of digestion takes place. This organ is just in front of the large muscular gizzard, the appearance of which must be familiar to all. Hard sharp pebbles are an essential part of the diet of fowls. These pebbles are retained within the gizzard and by the muscular contraction of the walls of the gizzard, together with the grinding of the pebbles within it, the grain and other solid portions of food consumed by the bird are reduced to a soft finely divided mass, which is now ready to yield up its nutrients for the nourishment of the bird, and so as the food moves along the intestine the absorption of nutrients takes place. The dung of poultry contains not only the used up food material but also the secretions from the kidneys.

Available Foodstuffs.

Maize.—This is perhaps the most readily obtainable foodstuff. It should constitute the bulk of the grain ration as well as being incorporated in wet or dry mashes to the extent of 30 to 35 per cent. It is rich in carbohydrates and has some protein. One of the most valuable properties of maize is its vitamin content. The yellow colouring matter of maize contains the vitamins. To get the best results from maize it should be fed as a cracked grain. For incorporating in mashes it should be finely ground and for the feeding of chickens fine grinding is necessary. Should it not be possible to obtain ground maize or maize meal, grain which has been cracked in an ordinary corn cracker may be sieved, the coarser particles remaining in the sieve being used for grain feed, whilst the sieved particles are used as a meal.

Rice.—Padi may be fed as a grain but owing to the indigestibility of the hull it is well to use padi mixed with cracked maize in the proportion of one to two parts. Broken rice, a bi-product of milling, adulterated with some broken hulls and bran, is useful as a scratch grain. If rice-bran free of husks was obtainable one would not hesitate to recommend it as the basis for wet poultry mashes in this country. Owing, however, to the impossibility of obtaining rice bran free from adulteration with broken hulls, one is loathed to recommend it for this purpose, the reason being that the large proportion of indigestible fibre in the adulterating rice hulls causes indigestion and lowers production. Pure rice bran is a good all round food of fairly close nutritive ratio.

Coconut Meal.—Of all local foods coconut meal is undoubtedly the most valuable owing to its richness in protein. In the milling process leading to the production of coconut meal a very large proportion of the fat is removed from the copra so that the resulting meal has a high proportion of protein in relation to the carbohydrate and fat remaining. It has fair keeping qualities and when kept in a dry place remains fresh for over a month. Coconut meal should not be incorporated in prepared mash mixtures because of the difficulty of breaking up the lumps when dry and the danger of dried lumps swelling in the gullets of birds and choking them. The meal therefore should be kept separate and wetted with water or milk using about equal quantities of fluid to meal. The meal absorbs the liquid, swells up and becomes coarsely granular. It may then be added to the other ingredients of a wet mash. About 25 per cent of the total ration fed to growing stock and adults may consist of coconut meal.

Molasses.—This product of the sugar mill is a useful source of carbohydrate easily obtainable in this country. It may be fed up to 10 per cent for adult birds. One way of using it being as a medium to wet the coconut meal.

Milk.—The most valuable and easily obtained source of animal protein is skim milk and wherever this can be obtained it should be added liberally to poultry rations. Milk is also rich in minerals and vitamins. When curdled, the whey is still a useful feeding substance whilst the protein is mostly concentrated in the coagulated portion.

Salt.—Common salt is necessary as an aid to digestion and should be incorporated in the ration in from a half to one per cent of the whole.

Grit.—The broken shells of oysters and other shell fish should be available at all times to enable the birds to satisfy their requirements for lime as they feel the need for it. It should not, however, be incorporated in mashes because of the risk of feeding an excess of lime, which is harmful.

Bone Meal.—This product is the best source of lime and phosphorus which fortunately occur in bone in the correct proportion for animal needs. Bones therefore should be saved and wherever possible put through some kind of small mill to produce a meal. The proportion of bone meal to feed is about two per cent of the total daily ration. This product may also be purchased locally.

Little has been written concerning the use of dalo, yam, tapioca and sweet potato as poultry feeds. They are, however, valuable, particularly for incorporating in wet mashes. In order to increase their digestibility it is well to boil these roots. When soft they may be mixed with coconut meal, maize meal and other ingredients to make a palatable wet mash for morning feeding.

Green Grass.—When birds have access to grazing they will derive considerable nourishment from the consumption of fresh green grass. The clippings from a closely mown lawn are useful for this purpose and are rich in protein.

The only imported foods which need be considered are the following:—

Pollard.—This is a most valuable food and when available may constitute about 40 per cent of wet mash.

Wheat Bran.—High mineral content is characteristic of this food which may be incorporated to about 10 per cent of the ration when available.

Meat Meal.—This is a dried pulverized product made from the meat scraps and offal from slaughter-houses. It is the most valuable available source of animal protein and in the absence of skim milk should constitute about 10 per cent of the ration.

In nature poultry derive most of their protein of animal origin from insects and grubs collected in the field, and wherever free range is possible for poultry it should be allowed.

Compilation of Rations.

Because of the difficulty of obtaining a large range of foodstuffs it is of little use including in this article formulae for fixed rations. It is sufficient to give an indication as to how one should go about formulating the ration. One should start with pencil and paper and jot down a list of foodstuffs which can be obtained. Then choosing from the list write down quantities per 100 parts of what one might call the standard food substance. For instance—

Salt, 1 part; bone meal, 2 parts; maize meal, 30 parts; coconut meal, 25 parts; total, 58 parts.

It is therefore still necessary to find 42 parts from some other source. If meat meal is available include 10 parts but it may be necessary to make up the whole of the 42 parts by the inclusion of mashed boiled roots. Few people would go to the trouble of actually weighing the different constituents of the food and most of them depend upon the use of some form of bulk measure so that the proportion in which they are actually included in the ration will be approximate only. If coconut meal is used, first of all measure the quantity of coconut meal required and wet it with about an equal quantity of skim milk or water or a mixture of molasses and water, then add the balance of the ingredients and mix them up into a mash, which should be, when prepared, damp but not soppy.

Owing to the limited number of feeds available it is almost impossible to advise a system of dry mash feeding and one therefore is obliged to depend upon the wet mash system. It is usual to give one feed of wet mash daily and one feed of dry grain, which is usually fed in the evening. Household scraps may also be incorporated in the wet mash feed in the morning and at midday an additional feed of green leaves, grass or garden crops (pawpaw, pumpkin) should be given. People living in country districts will usually have a fair range of these additional food substances available.

Amount to Feed.—If one is catering for a large flock it will be necessary to make careful estimates of the quantities of foodstuffs which will be required, according to the breed of poultry kept. Small hens will require about 3½ oz. of food daily calculated dry and the larger birds up to 4½ oz., but in view of the smallness of most flocks in Fiji and the fact that they are mostly kept for domestic use, it will be sufficient to judge the quantity of feed by the appetites of the birds, condition of the carcass and by egg production. The egg production of high producing hens fluctuates very readily in response to underfeeding or feeding food of poor quality and conversely when correct feeding is carried out production rapidly increases. The quantity of grain required is about 2 oz. per bird daily.

When to Feed.—The first meal consisting of wet mash should be given as early as possible after sunrise. About midday it is well to feed vegetable matter and late in the evening a good dry grain meal. If birds are fed too much soft mushy food the gizzard is apt to become weak-muscled with resultant poor digestive power. The affect of feeding hard dry grain in the evening is to stimulate the functioning of the gizzard overnight when the grain will be milled and digested in that organ.

Sanitation in Feeding.—All feeding utensils used for poultry should be washed daily so that they are maintained in as clean a state as possible. Feeding on flat, broad trays is not a good practice owing to the fact that the birds contaminate the food with their feet and possibly by droppings. A

trough raised a few inches off the ground is a good system so that the birds do not tread in the food. A good type of feeding trough can be made from a large bamboo with the side removed so that the curved sides prevent the spilling of the food and the birds stepping into the trough.

Watering.—An abundance of water should always be available for fowls and perhaps the best type of water vessel is a syphon pattern where only a small quantity of water is contained in the bottom of the vessel, the receptacle being fed by fresh water flowing in as the level falls. Avoid, if possible, wet places around the watering trough.

Chick Feeding.—Chicks, at least in their early stage, are best fed with a dry mash. The composition of the latter will again depend upon available feed materials. If skim milk is available that should be sufficient to provide them with their animal protein ration. A dry mash as a basis might contain 30 per cent ground yellow maize meal, ½ per cent salt and 2 per cent bone meal. Oatmeal, if obtainable, is an excellent food. Young chicks should not receive any food for the first 36 hours after hatching but during this period they should have access to clean, fresh water and very fine pebbles or grit. Their first feed should then consist of fine chick grain.

Difficulty may be experienced in keeping up the supply of fine chicken grain and it may be necessary after a few weeks gradually to bring the birds on to a wet mash in which coconut meal is incorporated. Seven per cent of molasses in the ration is a useful additional food. It may be used to wet the coconut meal.

Finally poultry feeders should constantly be on the lookout for additional feeding stuffs suitable for poultry. It is often possible to obtain slightly damaged oatmeal, sharps and rice at cheap prices and all of which are valuable poultry foods.

EXTRACT.

POVERTY AND MALNUTRITION IN SOUTH AFRICA.

The potential production of foodstuffs in South Africa is considered by Dr. Osborn to be more than sufficient to give each member of the community an ample balanced diet. Distribution is the major problem—getting the right food to the people, by increasing their purchasing power, subsidizing consumption, or free distribution. Milling practice in the cereal industry is criticised and it is shown that it is essential that the germ of the wheat should go back into refined flour and mealie meal. The conversion of more skim milk into food for human consumption, development of the margarine industry on the grounds of price, in spite of the butter surplus encouragement of soya bean growing, of the consumption of meat, fish and peanuts by the poorer sections of the community, and of the use of vegetables and fruit rich in vitamin C, such as guavas and red peppers, are also advocated.

The consumption of these foods so as to eliminate malnutrition should be encouraged within the present economic framework by a system of subsidies, preferably a combination of free distribution, subsidy to the consumer and subsidy to commerce. Dr. Osborn cites for example a scheme to encourage the use of mealie meal containing five per cent of soya bean meal, and then discusses the long-term solution of the problem of removing poverty in the midst of plenty. This means raising the general standard of living and making the economic struggle for existence less intense and ruthless. The final aims are to induce the maximum of economic efficiency, economic equity and personal freedom. —H.W.J.

—*Nature*, No. 3766, January 3, 1942.

ENTOMOLOGICAL NOTES.

By
R. J. A. W. LEVER, B.Sc. (Hons.), D.I.C. (Lond.), A.I.C.T.A., F.L.S.

1. SPREAD OF THE GREEN VEGETABLE BUG *Nezara*.

The range of the green vegetable bug, *Nezara viridula* L. *smaragdula* F., was shown in the issue for March, 1942 (1) to have extended to Taveuni and Rabe Islands. Information has since been received of this bug occurring in three islands of northern Lau, viz., Naitauba, Kanacea and Mago, it being a pest of asparagus and broccoli, besides bean and tomatoes, on the first-named island. Supplies of the parasite *Microphanurus basalis* Woll. were sent to Naitauba and Kanacea, arrived in good condition and were liberated. Up to the end of August 10,500 were liberated in the Colony.

It is now desirable to confirm the doubt expressed previously (2) about Tillyard's record of it in New Zealand as it does not occur there but is a pest of rice, cowpea, pigeon pea, *Crotalaria*, pumpkins, cucumbers and okra in New Britain and of *Crotalaria*, *Nasturtium* and snap dragon in Tonga. Besides cowpea (*Vigna sinensis* Wulp.) and beans in Fiji, *Nezara* has been taken on pea (*Pisum sativum* L.). A new record is Papua in south-east New Guinea.(3)

REFERENCES.

(1) Lever, R. J. A. W., 1942. *Agric. Journ. Fiji*, Vol. 13, No. 1, March.
(2) *Ditto*, 1940. *Ibid.*, Vol. 11, No. 3, Sept.
(3) Freeman, 1940. *Trans. Roy. Entom. Soc.*, London, Vol. 90, Pt. 12, Sept.

2. THE GIANT TOAD IN SOME PACIFIC ISLANDS.

The South American giant toad (*Bufo marinus* L.), introduced into Fiji from Honolulu in 1936, was liberated in New Guinea in the following year. The accompanying extract * will be of some interest as the spread of this amphibian is unlikely to be greatly modified by this area becoming a theatre of war:—

"Cultivation of sweet potatoes (*Ipomoea batatas*) on the plantation has for many years been governed by the frequency and severity of attacks made by the larva of the moth (*Hippotion celerio*). These attacks became so frequent and severe that from 1935 until 1938 it was impossible to produce an economic crop, and only a very small area could be kept in cultivation by repeated dusting and hand-picking.

In February, 1937, the giant toad (*Bufo marinus*) was introduced from Queensland. It quickly accustomed itself to the plantation climatic conditions and commenced to breed in large numbers. The first results of the activities of the toad were to be seen towards the end of 1937, when attacks by cutworms on the lawns were observed to have ceased. In May and June, 1938, a large area was planted with sweet potatoes and the crop matured and produced a very good yield."

Both the sweet potato hawk moth and cutworms occur in Fiji (110 of the latter insect were found within the stomach of one toad disected in 1939) so its usefulness for this Colony is hereby again demonstrated.

Following the safe arrival of 150 adult toads sent from Suva to Funafuti Atoll in the Ellice Islands in November, 1939, the local administration had them carried to Vaitupu still further north. In the following February supplies were sent from Fiji to the British Solomon Islands Protectorate and the toads were said to be thriving on Guadalcanal and other islands much hotter and moister than any in Fiji.

* Report to League of Nations on Territory of New Guinea; July 1938–June 1939. Canberra, 1940.

3. BEETLE BORERS IN STORED DERRIS.

A sample of *Derris elliptica* Benth., grown and stored for months in Sigatoka, was examined in Suva in bags and found to have the largest roots drilled with holes of two sizes, 1/8 inch and 1/32 inch in diameter. The larger were caused by the black borer *Xylothrips religiosus* Boisd. a well-known pest of avocado, mahogany and other trees(1) and the smaller by a Lyctid beetle, *Minthea* sp., measuring one-eighth of an inch in length. Parasitic on one or both of the larvae is a somewhat sluggish brown Chalcid awaiting determination and predators are the larvae of the shining chestnut brown cadelle beetle *Tenebroides mauritanicus* L. A second predator is a grey Reduviid bug with black membranes on the forewings. Further details will be published later but this note appears here in order to enable growers to have the benefit of research, carried out eight years ago in Malaya(2), in the control of these beetles. Prevention of infestation should include most of the following measures which are as applicable here as in the Far East:—

1. Cut the roots into portions about 2 inches long, and dry in sun. Store in tightly fitting chests.
2. Sunning alone on fine bright days kills the grubs.
3. Fumigation with carbon bisulphide when the weather prevents thorough sunning for several hours at a time.
4. Cleanliness in the store-room by removal of waste material: this is recommended for all stored products but is often the measure most ignored.

The cultivation of the Malayan *elliptica* is preferable to that of the Pacific *trifoliata* Lour. or duva, formerly referred to as *uliginosa*(3) (4), which is only about one-sixth as toxic as *elliptica*.

REFERENCES.

(1) Lever, R. J. A. W.—1940. *Agric. Journ.*, Fiji, Vol. 11, No. 2.
(2) Miller, N. C. E.—1934. Dept. of Agric. S.S. & F.M.S., Scientific Series No. 14. Singapore.
(3) Blackie, W. J.—1932. *Agric. Journ.*, Fiji, Vol. 5, No. 1.
(4) Lever, R. J. A. W.—1935. *British Solomon Islands Agric Gazette*, Vol. III, Nos. 2 & 3.

EXTRACT.

AGRICULTURE AFTER THE WAR.

Recently Sir John Russell, F.R.S., Director of Rothamstead Experiment Station in England has called attention to the deficiencies in the British attitude towards farming in the past and the need for new proposals for future reconstruction. He quotes Sir Daniel Hall's latest book *Reconstruction and the Land* wherein large land units are advocated, necessitating purchase of large areas for cutting up into suitable size and bringing into proper agricultural condition before settlement.

Proper agricultural condition would include farming, preparation of pastures, drainage, housing, sanitation, access roads, marketing and recreation centres, provision of essential implements and stock, etc., since if the land is to be occupied it must be made attractively occupiable for potential settlers.

" The proposal will certainly receive the serious consideration which Sir Daniel's distinguished authority requires ".

(In Fiji, similar consideration might well be given to projects for preparing mixed farms for ex-soldiers and for Europeans of mixed descent as being a material factor towards meeting the half-caste problem which is yearly becoming more pressing.) —H.W.J.

Nature, No. 3766, 3rd January, 1942.

OBSERVATIONS ON SOIL METHODS, PART 2.

By
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and
A. I. BIGGS, B.Sc.

In a previous paper Blackie ([12]) discussed soil methods from the viewpoint of soil surveys and made reference to the necessity of standardization of techniques, and the adoption of more rapid methods. During the last five years considerable attention has been directed in many laboratories to short cuts in soil methods and many and varied techniques have been evolved. In this laboratory we have occasion to examine many soils in the course of the year both from the agricultural point of view and also in connexion with soil survey studies. It was considered therefore that our work would be facilitated and more rapid progress made in a small laboratory with limited trained staff if the claims made for certain of these methods could be substantiated in practice with tropical soils.

In this paper observations are recorded in connexion with recent methods for the determination of phosphorus and potassium and the description of reliable techniques using hydrochloric acid extracts of tropical soils is given.

(A).—THE COLOURIMETRIC DETERMINATION OF PHOSPHOROUS IN SOILS.

Many methods have been developed for the colourimetric estimation of phosphorus in soils but several of these loose their efficiency due to interference from other elements, notably iron and silica, which occur in hydrochloric extracts. Determinations made by the classical methods of King ([1]) and Robinson ([2]) although accurate are lengthy and wasteful of chemicals.

Most colourimetric methods for the estimation of phosphorus which have been devised in recent years are based on the formation of a blue colloidal solution of molybdic oxide formed by the reduction of ammonium phosphomolybdate under certain standardised conditions.

This method was first described by Osmond ([3]) and developed by Deniges ([4]) and since that time many modifications concerned chiefly with the composition of the sulphomolybdic acid solution and the nature of the reducing agent have been developed.

Concerning the reducing agent Deniges ([4]) used stannous chloride, Bell and Doisy ([5]) and Briggs ([6]) used hydroquinone and Fiske and Subbarow ([7]) used 1,2,4, aminonapthosulphonic acid.

Deniges method has had considerable success with certain soil extracts but is considered to be unreliable with acid extracts of soils containing a concentration of iron salts greater than 10 parts per million. This has been our experience with the Deniges method with highly ferruginous soils. By using a perchloric acid soil extract and 1,2,4, aminonapthosulphonic acid Sherman has been able to accurately determine phosphorus in an iron concentration up to 200 parts per million using a photoelectric colourimeter and red filters.

Perchloric acid extracts of soil do not necessarily contain similar amounts of phosphorous to that contained in the hydrochloric acid solution in general use and although there is no doubt but that the Sherman ([8]) method could be adopted for hydrochloric acid extracts additional operations would be necessary.

From a survey of the literature it would appear that the hydroquinone reduction method has not been systematically applied to the estimation of soil phosphorus. Briggs [6] applied this reduction technique to the estimation of phosphorus in biological fluids and its usefulness in that field suggested its adoption with soil extracts.

In the following a study has been made of:—

(1) the suitability of the hydroquinone reduction technique for the determination of phosphorous in acid extracts of soils by the standard technique;

(2) the influence of accompanying iron salts on the determination;

(3) the conditions necessary to offset interference and the elaboration of a successful technique.

Interference caused by the presence of Iron Salts.

The presence of iron salts in certain concentrations has a marked effect both on the nature of the colour and its stability. This has been pointed out by several workers. The soils of Fiji, particularly the lateritic types, give up considerable iron to acid extracts and by the normal Deniges method it was found that greenish blue solutions were developed which were unstable and difficult to match with standards.

Using the hydroquinone reduction technique a study was therefore made of (1) the effect of iron salts of varying concentrations on the phosphorous estimation (2) methods directed to the limitation of the iron effects.

Experimental.—Using solutions of phosphorus concentrations amounting to 0·01 mgs. per cubic ml., quantities of ferric chloride were added to give a range of 10 to 400 parts per million of iron present.

In the first series of experiments an aliquot was taken of each solution and the phosphorous content determined by the technique to be described subsequently.

Table (1) records the recovery of phosphorus at the various iron concentrations:—

Table 1.

Iron concentration.	Per cent recovery of phosphorus.
10 p.p.m.	100
20 ,,	100
25 ,,	100
30 ,,	100
50 ,,	96
75 ,,	94
100 ,,	91
125 ,,	88
150 ,,	84
200 ,,	80

p.p.m. = parts per million.

From these figures it can be seen that:—

(1) phosphorus can be accurately determined by the hydroquinone method in the presence of iron up to a concentration of 30 p.p.m.;

(2) as the iron concentration increases above 30 p.p.m. the recovery of the phosphorus present gradually decreases.

In the second series of experiments, a similar set of solutions was used and an aliquot of each was taken equal to 10 c.c. Each portion was evaporated to dryness on a water bath and then heated over a flame for three to five minutes. The residue was extracted with 50 mls. of 2N sulphuric acid on a water bath for 10 minutes and then filtered, the filtrate being made up to 100 c.c. and thus normal in sulphuric acid.

An aliquot of each solution was then analysed colourimetrically for phosphorus as before with results as follows:—

TABLE 2.

Iron concentration.	Per cent recovery of phosphorus.
10 p.p.m.	100
20 ,,	100
40 ,,	100
50 ,,	100
75 ,,	100
100 ,,	100
150 ,,	100
175 ,,	100
200 ,,	100
225 ,,	100
250 ,,	99
300 ,,	98
400 ,,	95

From a consideration of these results it is apparent that:—

(1) phosphorus can be completely determined in the presence of iron up to a concentration of 230 p.p.m. of iron by the method used;

(2) 98 per cent recovery can be obtained up to a concentration of 300 p.p.m. of iron.

EFFECT OF ACIDITY ON THE BLUE COLOUR.

The medium in which the colourimetric test solutions are prepared is sulphuric acid and it has been recorded by several workers that a variation in the acidity of the medium in which the development of the blue colour takes place causes a change in the depth of colour of solutions at the same concentration. As a result of these observations a series of experiments was carried out, to correlate colour density with acidity. A set of solutions was made up of varying acid concentrations between nil and 2·5N, each solution containing a phosphorus concentration of 0·01 mgs/ml.

In one experiment the blue colour, developed in the normal manner, was allowed to stand for 15 minutes and the depth of the blue colour compared with standard glasses of a Lovibond tintometer. It was found that the colour increases in depth up to a normality of 0·50 and then decreases until a normality of 0·72 is reached. Between 0·72 and 1·22N the colour depth is stable.

In another experiment the blue solutions were heated to a temperature of 95°C allowed to cool and the colour intensity determined as before. In this case it was found that the optimum acidity is between 0·6N and 1·1N and that the blue colours within this range were much deeper in hue.

Study of (1) the effect of heating the test solution to 95°C. (2) Comparison of test solutions:—

(*a*) left standing 20 minutes;
(*b*) heated to 95°C.

From the literature on colourimetric methods of determining phosphorus it has been the general practice to leave the test solutions standing from 15 to 20 minutes before comparing in a colourimeter. Reference has been made to heating the solutions but it has not been incorporated in any particular method. This study aimed at finding what were the results of heating the standards, what advantages could be obtained by doing so and whether any degree of consistency could be secured. Sherman [8] has recorded that the blue colour varies according to the temperature and that results were very erratic at a temperature above 36°C. It was decided to ascertain whether the colour concentration remained constant at temperatures near the boiling points of the test solutions.

It was noted from experiment that the blue developed more rapidly if the solutions were heated and that the depth of blue colour was deeper than in the cases when the solutions were allowed to stand for 20 minutes. The extra depth of colour obtained by heating seemed to indicate that when the test solutions were heated the lower limit of the phosphorus concentration which could be determined would be greater than when the solutions were allowed to stand.

Several sets of standards of phosphorus concentration 0·1 mgm. per c.c., 0·01 mgm. per c.c., 0·001 mgm. per c.c. were prepared and the solutions heated to 95°C. after preparation. In each series of concentrations, one test solution was fixed in the colourimeter and the others compared with this solution in the colourimeter and the values recorded in Table 3.

TABLE 3.

1. *Strength of Solution* = 0·01 mgm. per c.c.

Test solution reading.	Reading of other solutions.
Set at 30 mm. depth	30 mm.
	30 mm.
	30 mm.
	30 mm.

2. *Strength of Solution* =0·001 mgm. per c.c.

Test reading.	Reading of other solutions.
Set at 30 mm. depth	30 mm.
	30 mm.
	30 mm.
	30 mm.

In a second series of observations solutions of different strengths were made up in duplicate, one was allowed to stand for 20 minutes and its colour strength determined against standard Lovibond glasses and the other in each case was heated, on preparation, to 95°C., allowed to cool and then compared with standard glasses as above. In addition the colours were compared in pairs in a colourimeter, the value of the colours developed by standing being fixed and the values of the heated solutions determined against the solution of the same phosphate strength.

The set value of the standing solutions which were used in the colourimeter was 20 mm. A study of the results obtained indicate that as the concentration of the phosphorus increases the depth of the blue colour in both cases gradually converges and at a concentration of approximately 0·10 mgm. of phosphorus per ml. the strength of the blue colour for solutions which have been standing for 20 minutes and heated is the same. In addition, it was noted that the ratio of the depths of blue colour for standing solutions and heated solutions varies with the concentration of phosphorus which makes it impossible to compare solutions, some of which have been allowed to stand for 20 minutes and some allowed to heat to 95°C.

Details of the Colourmetric Method.

The colourmetric method using hydroquinone as a reducing agent adopted by the authors for acid extracts of soils can be summarized as follows:—

1. A hydrochloric extract of the powdered soil sample is made up in the usual manner.

2. A 25 c.c. aliquot of the hydrochloric extract is evaporated to dryness on a water bath and heated over a flame for five minutes in order to render iron and silica insoluble.

3. The residue is treated with 10 c.c. of 2N sulphuric acid, warmed on a water bath for 10 minutes and filtered through a tough filter paper and the filtrate diluted to give an approximate strength of 0·01 mgm. per c.c. of phosphorus.

4. Preparation for colourimetric observation.

To a 5 c.c. aliquot of the filtrate add 2 c.c. of ammonium molybdate solution, 2 c.c. of sodium sulphite solution and 1 c.c. of hydroquinone solution in that order.

Warm the solution to just below boiling in a 50 c.c. Pyrex flask and allow to cool before comparison with a standard solution prepared in exactly the same manner.

5. The solutions are compared with the standard in a colourimeter and the phosphorus concentration in the soil extracts calculated.

Precautions.

1. Fresh standards should be made up for each set of determinations owing to the fact that the colour of the standards varies when allowed to stand even for a short period. It also obviates any difference which may have occurred in the preparation of the solutions.

2. The same instruments such as pipettes, burettes should be used in all determinations as a precaution against instrumental errors.

3. All chemicals must be pure, particularly those used in preparing the final comparison solutions.

4. The roasting of the hydrochloric acid extract is to ensure that silica and iron are cut down to a minimum in the final test solution.

5. Both standards and unknown solutions must be brought to an acidity between 0·75N and 1·1N. This is carried out when the solution is being diluted to the required concentration.

6. Standards and test solutions must be prepared at the same temperature.

Experimental Results with Proposed Technique.

Table 4.

With pure Solutions of known Concentration.

Calculated value as phosphorus.	Experimental value as phosphorus.
0·11 mgm. per c.c.	0·11 mgm. per c.c.
	0·11 ,,
	0·11 ,,
0·011 mgm. per c.c.	0·011 ,,
	0·011 ,,
	0·011 ,,
0·001 mgm. per c.c.	0·001 ,,
	0·001 ,,
	0·001 ,,

From the results listed above it can be seen that 100 per cent recovery can be obtained on synthetic solutions where no interference is suffered from other elements present in solution.

Method tested on Soils.

In these experiments two soil samples of extreme types were taken and the hydrochloric extracts treated by both the A.O.A.C. volumetric method and the colourimetric method described above. The results were compared and are tabulated below.

Table 5.

Soil.	Colourimetric technique.	By A.O.A.C. method.
A	0·047 per cent P_2O_5	0·048 per cent P_2O_5
	0·048 ,,	0·048 ,,
	0·048 ,,	0·049 ,,
	0·047 ,,	0·047 ,,
B	0·030 ,,	0·029 ,,
	0·030 ,,	0·030 ,,
	0·031 ,,	0·030 ,,

It can be seen that the results secured by the colourimetric method are in close agreement with the results obtained by the official A.O.A.C. method and the soils on which the comparison was made were typical Fiji laterites and contained a high percentage of iron salts.

Reproduction of Results by the Colourimetric Method.

Several tests were carried out on three soils, three rock phosphates and three standards; the aim was to determine to what extent results could be reproduced using the hydroquinone method. The results are recorded in Table 6.

Table 6.

Sample.	1st result.	2nd result.
Soil A	0·029 per cent P_2O_5	0·030 per cent P_2O_5
Soil B	0·011 ,,	0·011 ,,
Soil C	0·047 ,,	0·048 ,,
Phosphate Rock A	39·20 per cent P^2O^5	39·24 ,,
Phosphate Rock B	33·39 ,,	33·25 ,,
Phosphate Rock C	31·10 ,,	31·30 ,,
Standard A 0·44 mgm. of P ..	0·44 mgm. P	0·44 mgm. P
Standard B 0·22 mgm. of P ..	0·22 mgm. P	0·22 mgm. P
Standard C 0·100 mgm. of P ..	0·100 mgm. P	0·100 mgm. P

It can be readily seen that the results given by the method are reproducible, the maximum deviation with soils and phosphate rocks being two per cent and on standard solutions the reproduction is 100 per cent.

The Application of the Hydroquinone Reduction Technique to the Colourimetric Determination of Phosphorus in Phosphate Rock.

During the course of this investigation several samples of phosphate rock were received for analysis and opportunity was thus afforded to test out the method on these samples and compare the results obtained with the official technique.

Although it was not expected that the method would be as accurate as the official method it has certain advantages in the way of speed and cheapness in the expenditure of chemicals which cannot be ignored. The results obtained by the method and those obtained by an independent analyst using the official technique are surprisingly good and indicate that the method has possibilities as a routine procedure where extreme accuracy is not required. Owing to differences in the nature of the extracting medium and the high amounts of phosphorus in the phosphorus rock, slight alterations were effected in the technique developed for soils.

Modified Method for use with Phosphate Rock.

1. The phosphate rock is extracted with a mixture of 15 ml. of nitric acid and 10 ml. of hydrochloric acid and warmed until digestion is complete.

2. The filtrate from the above is made up to 200 c.c. and an aliquot evaporated to dryness on water bath, heated for 5 minutes and extracted on a water bath for 10 minutes with 2N sulphuric acid.

3. The filtrate is diluted to an approximate concentration of 0·01 mgm. per c.c. and to normal acidity.

4. An aliquot is prepared by the method described under soils and compared with a standard solution of 0·01 mgm. per c.c. treated in the same manner.

The method was found to be accurate and very rapid when compared with the time taken for phosphate determined by the usual volumetric method. Several phosphate samples were determined by both the colourimetric and the volumetric methods and a comparison of the results obtained by the two methods is recorded below:—

Table 7.

Phosphate.	By the Volumetric method.	By Colourimetric.
1	31·10 per cent P_2O_5	31·30 per cent P_2O_5
2	22·90 ,,	22·70 ,,
3	39·10 ,,	39·19 ,,
4	38·46 ,,	38·50 ,,
5	38·77 ,,	38·50 ,,
6	23·26 ,,	23·50 ,,
7	30·06 ,,	30·05 ,,
8	34·30 ,,	34·10 ,,
9	33·30 ,,	33·50 ,,
10	37·80 ,,	37·50 ,,

Preparation of Standard Solutions and Reagents.

Ammonium Molybdate.—Dissolve 5 grams of Analar phosphate free ammonium molybdate in 95 c.c. of distilled water. This solution will keep for quite a long period.

Sodium Sulphite.—Dissolve 20 grams of sodium sulphite in 80 grams of distilled water. The sodium should be re-crystallized from a hot saturated solution until it is phosphate free and will not give a blue colour on a blank test. The sulphite should not be allowed to stand too long before being used because it oxidizes and loses its reducing properties.

Hydroquinone.— ·5 grams dissolved in 100 c.c. of water and 1 c.c. of 1N sulphuric acid added.

Standard Sodium Dihydrogen Phosphate.—Dissolve 4·5941 grams of Analar sodium dihydrogen phosphate in water and make up to 1 litre. This gives a solution with a phosphorus concentration of ·001 grams per c.c.

Summary.

If attention is given to certain details of technique as described in this paper the Briggs method of determining phosphorus in biological fluids colourimetrically using hydroquinone as the reducing agent can be adapted to acid extracts of soils and the method is both simple, accurate and speedy in execution. Further, the method can be used for the determination of phosphorus in rock phosphate where speed rather than extreme accuracy is the order.

(B) THE COLOURIMETRIC DETERMINATION OF POTASSIUM IN SOILS.

The classical methods of determining potassium by the platinic chloride, perchlorate and cobaltinitrite methods give accurate results but as with classical phosphate methods they are time consuming and wasteful of chemicals. Within recent years the cobaltinitrite method has been developed by several investigators chiefly Piper ([9]) Steenkamp ([10]) and Siderus ([11]) for the determination of micro quantities of potassium in soil extracts using either micro volumetric or colourimetric techniques. In the volumetric method of Piper difficulty is experienced in deciding the end point of the titration and in the method of Steenkamp the green colour developed by the sodium bicarbonate solution of the potassium cobaltinitrite precipitate is difficult of accurate comparison in a colourimeter.

The Nitroso-R salt modification of the cobaltinitrite method as developed by Siderus gives a red coloured solution for comparison with standards in a colourimeter and furthermore the standards and tests require less preparation than is the case with other colourimetric methods.

Certain difficulties are experienced with cobaltinitrite methods particularly the solubility of the potassium cobaltinitrite precipitate in washing solutions and the stability of the developed colour.

In the following reinvestigation of the nitroso-R salt modification of the cobaltinitrite method we draw attention to certain limiting factors effecting accuracy and suggest a technique for the determination of potassium in soils which has given excellent results in our hands.

Experimental.—Siderus has stated that the washing of the potassium cobaltinitrite precipitate with water results in substantial losses and that washing with 70 per cent alcohol yielded better returns. Experiments were carried out on precipitates developed from standard solutions some being

washed with water and others with a 70 per cent alcohol solution and the results compared. Table 8 gives a brief summary of these results and it can be seen that wheras the water washed precipitate gave an average recovery of 94 per cent, the alcohol washed precipitate gave an average recovery of 99 per cent.

TABLE 8.

Known valu = 73 mgms. of potassium.

(*a*) When washed with water	1	0·708 mgms. K.
	2	0·664 ,,
	3	0·700 ,,
	4	0·700 ,,
	5	0·688 ,,
(*b*) When washed with alcohol	1	0·720 ,,
	2	0·730 ,,
	3	0·728 ,,
	4	0·724 ,,

The effect of the presence of ammonium salts was next studied and it was found that the ammonium radicle lowered the recovery by as much as 25 per cent. The same samples, if heated for two or three minutes before extraction to remove ammonium salts, gave an average recovery of 99 per cent. Table 9 summarizes these results:—

TABLE 9.

Known amount potassium = 0·730 mgms. K.

	Ammonium radicle present.	Ammonium salts destroyed.
1	0·640 mgms. K	0·724 mgms. K
2	0·560 mgms. K	0·720 mgms. K.
3	0·590 mgms. K	0·730 mgms. K.

It is stated by Siderus that the red colour which is used for comparison purposes in the Nitroso-R salt method will remain stable for a day or two. During these experiments a series of low results was encountered and it was noticed that these coincided with the use of standard comparison solutions which were not freshly prepared. Consequently it was decided to test the stability over a period of 24 hours. Table 10 shows the results and indicates that the red colour fades sufficiently in 24 hours to give an average error of 3·5 per cent.

TABLE 10.

	Using fresh standard.	Using standard prepared 24 hours.
1	0·720 mgms. K	0·690 mgms. K.
2	0·730 ,,	0·710 ,,
3	0·680 ,,	0·660 ,,
4	0·580 ,,	0·560 ,,
5	0·136 ,,	0·130 ,,

From these figures it is apparent that standard solutions which have been standing over a period are unreliable and will give inaccurate results, the inaccuracy depending upon how long the solution has been standing. To get the best results from the method standard comparison solutions should be made up at the same time as the test solutions.

During the precipitation of the potassium cobaltinitrite, a period of time is required, ranging from four hours to overnight. Siderus recommends overnight if possible but it has been found that if a small quantity of dilute nitric acid is added to the solution during precipitation, the time required can be reduced to 1 hour. Comparative tests were made for which solutions of the same strength were precipitated by leaving to stand for 12 hours and by adding 3 mls. of 0·1N nitric acid and leaving to stand for one hour. Table 11 gives a summary of the results.

TABLE 11.

		No acid 12 hours.	3 ml. nitric acid 1 hour.
1		0·720 mgms. K	0·720 mgms. K
2		0·728 ,,	0·730 ,,
3		0·724 ,,	0·730 ,,
4	Soil	0·115 per cent K_2O	0·115 per cent K_2O
5	Soil	0·114 ,,	0·115 ,,

By using the small quantity of dilute nitric acid a considerable saving in time can be effected. Furthermore the method is as accurate as the same method when the time for precipitation is 12 hours. The nitric acid is added at the same time as the sodium cobaltinitrite and the solution allowed to stand in a refrigerator.

NITROSO-R SALT METHOD.

The method and technique used in our investigations can be summarized as follows:—

1. A hydrochloric acid extract of the soil sample is prepared in the usual manner.

2. The extract is filtered and an aliquot approximately equal to 1 mgm. of potassium is evaporated to dryness on a water bath.

3. The residue is gently ignited over a flame at dull red heat for a few minutes to remove ammonium salts and dehydrate colloidal silica.

4. The residue is extracted on a water bath for 15 minutes with 20 c.c. of water and filtered (use a tough filter paper).

5. The filtrate is evaporated down to 1 c.c. in a centrifuge tube.

6. 1 c.c. of sodium cobaltinitrite is added, the solution agitated and 3 c.c. of ·1N nitric acid added.

7. Solution is set aside in a refrigerator for one hour to allow of complete precipitation.

8. The precipitate is centrifuged for five minutes at 1500 r.p.m. and the supernatant liquid is decanted.

9. The precipitate is washed with 75 per cent alcohol, centrifuged and decanted.

10. This washing is repeated.

11. The precipitate is dissolved in 5 c.c. of 2N sulphuric acid and warmed in a water bath at 70°C.

12. The solution is diluted to a concentration of approximately 0·01 mgm. per c.c.

Preparation for the Colourimeter.

1. To 10 c.c. of the solution add 2 c.c. of sodium acetate and 1 c.c. of Nitroso-R salt solution.

2. Shake to develope the red colour and compare with a standard solution prepared in the same way, the strength of the standard solution being ·01 mgm. of potassium per c.c.

3. Calculate the amount of potassium in the soil sample.

Table 12.

Results using the Colourimetric Method.

Solution.	Known concentration.	Experimental result.	Per cent recovery.
1	0·720 mgms. potassium	0·72 mgms. potassium	100 per cent.
2	0·730 ,,	0·724 ,,	99·4 ,,
3	0·730 ,,	0·720 ,,	99·0 ,,
4	0·730 ,,	0·726 ,,	99·5 ,,
5	0·730 ,,	0·730 ,,	100·0 ,,
6	0·730 ,,	0·720 ,,	99·0 ,,
7	0·730 ,,	0·730 ,,	100·0 ,,
8	0·730 ,,	0·720 ,,	98·8 ,,
9	0·730 ,,	0·724 ,,	99·4 ,,
10	0·730 ,,	0·730 ,,	100·0 ,,
1	0·116 ,,	0·114 ,,	98·5 ,,
2	0·116 ,,	0·116 ,,	100·0 ,,
3	0·116 ,,	0·116 ,,	100·0 ,,
4	0·116 ,,	0·115 ,,	99·3 ,,
5	0·116 ,,	0·115 ,,	99·3 ,,
6	0·116 ,,	0·114 ,,	98·5 ,,

As can be seen from the above results the average recovery is very high, 99·4 per cent.

Summary.

Provided that attention is devoted to certain details of technique as described in this communication, reliable and rapid results can be obtained for potassium in acid extracts of soil by the Nitroso-R salt modification of the cobaltinitrite method, using colourimetric methods of comparison.

References.

(1) King, E. J. *Biochemical Journ.* 26, 292, 1932.
(2) Robinson, W. O. U.S. Dept. Circ. 139, 13, 1930.
(3) Osmond, F. *Bull. Soc. Chim.* 47, 745, 1887.
(4) Deniges, G. *Compt. rend. Soc. biol* 84, 875, 1921.
(5) Bell, R. D., and Doisy. *J. Biol. Chem.* 44, 55, 1920.
(6) Briggs, A. P. *Ibid* 53, 13, 1922.
(7) Fiske, C. H. and Subbarow, Y. *Ibid* 66, 375, 1925.
(8) Sherman, M. S. *Ind. and Chem. Eng.* Anal. Ed. 14, 2, 182, 1942.
(9) Piper, C. S. *Journ. Soc. Chem. Ind.* 53, 396T, 1934.
(10) Steenkamp, J. L. *Journ. South African Chem. Inst.* (Division of Chemistry, series 110 South Africa), 1930.
(11) Sideris, C. P. *Ind. and Chem. Eng. Anal.* Edit. 9, 2, 145, 1937.
(12) Blackie, W. J. *Fiji Agric. Journ.* 8, 1, 12–16, 1935.

NOTES ON PADI VARIETIES GROWN IN FIJI.

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For several years past the Department of Agriculture has been working on the problem of mixed varieties in padi. The mixture of varieties brought about mainly through the indiscriminate changing over from one variety to another, without the exercise of due precautions in thorough cleaning of fields and of crop rotation to cope with "volunteer" plants from the previous crop, has reflected upon farm economy and has proved a source of trouble to the miller.

A programme of padi classification was recently instituted at the General Experimental Station, Sigatoka. Sixty samples from the different rice-growing districts of Fiji made up the material for trial and classification and work has been done on these now for two seasons.

Observations made on these varieties during and after growth may be of general interest. Twenty samples were found to be pure, Nadi and Vanua Levu supplying five each. Forty samples contained mixtures ranging from two to six varieties, one sample from Tailevu containing six varieties while samples from Navua and Lautoka contained up to five varieties; Vanua Levu and Nadi had mixtures containing up to three varieties.

An interesting feature noted was the difference in the names given to the same variety in different districts:—

China Patna or Lakarahawa.
Gazi or Chetewa.
Bandala, Lautoka, Motaka or Lal Dhan.
Patarka or Mehi.
Motka, Table, China or Bandala.
Serya Patna, Lalcar or Lulcaor Sarya.
Karia or Bagari.

This variation in nomenclature in a small colony is highly undesirable. A uniform system of numbering the different varieties would probably remedy the present system of conflicting names.

An undesirable feature about the popular variety known as Motka or Table Rice is its lateness in maturing. A variety received from Vanua Levu designated "Table Rice grown in brackish water" ripened in 173 days whereas the usual maturation period for Motka is over 200 days.

The sixty samples, after two years of observation were reduced and classified into twenty-nine varieties as follows:—

With respect to maturation period:—
Early—three varieties with an verage maturation period of 145 days.
Midseason—24 varieties with an average maturation period of 176 days.
Late—two varieties with an average maturation period of 212 days.

With respect to length of grain:—
Short, 11 varieties.
Medium, 8 varieties.
Long, 10 varieties.

The length of grain ranged from 4 millimetres to 8 millimetres.

Yield per acre varied greatly, ranging from 760 lb to 4,000 lb as calculated from the yields of one-fortieth acre plots.

3,000 to 4,000 lb = 11 varieties.
2,000 to 3,000 ,, = 11 ,,
1,000 to 2,000 ,, = 6 ,,
Under 1,000 lb = 1 ,,

Facilities for obtaining milling percentage for small samples were not available.

Judgment of flavour is a matter of taste and, therefore, arbitrary. In general it was found that thin-grained varieties had the better flavour. One variety was scented. Of the 29 varieties two were classed as excellent, 19 as good, six as fair and two as poor.

With respect to cooked grain characters the classification were:—

Sticky, 9 varieties; Free, 20 varieties. Time to cook ranged from 20 to 50 minutes.

It is hoped that next year a variety yield trial will be conducted with the most promising varieties.

EXTRACTS.

NEW WORLD ORDER.

A statement by Sir John Orr, F.R.S., Director of the Rowatt Research Institute, shows that the real task is the building of a new world in which all men in all lands will enjoy freedom from fear and freedom from want, as promised in the Sixth Article of the Atlantic Chapter.

The old world which had within it both good and bad is undergoing metamorphosis. An evident irreversible change is the transition to a World State, with the organization of a properly constituted government based on a sound world economic policy with a world police to maintain law and order.

The only way to reach agreement is to go back to fundamentals, the provision of the necessities of life, namely, food, shelter and work (a psychological necessity). If every family had a home in which they could live decently, food on the health standard and a feeling of absolute security that they would never fall below that level, we should have an economic and social foundation upon which we could begin to build a new world, which in time would provide for a still fuller life.

As Mr. Roosevelt has pointed out, the standard of living of the masses of the people is so low that if we undertook to provide satisfactory homes and adequate food for everybody, there would be work for every man and woman seeking a job. Every man, rich or poor, should be made to do some useful work. A national service corps in which every man would serve for one year would provide for this and thereafter each individual could find work, or if not, could continue to work in the corps, for which he would be assured a decent living and poverty would be abolished. A food policy based on human needs would be the spearhead for agricultural and economic prosperity. It is estimated that the production of protective foods alone, such as milk, eggs, fruit and vegetables, could be increased by 100 per cent and the provision of farming equipment would immensely stimulate industrial products.

This policy may seem Utopian. It is merely the policy of the good neighbour. Until governments in their dealing with each other reach the moral standard which regulates neighbourly relations, the world will never be free from war.

[In planning post-war settlement in this Colony many of Sir John's dictums might well be borne in mind, (especially as concerns the settlement of ex-soldiers of partly European descent).] —H.W.J.

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POST-WAR AGRICULTURAL RECONSTRUCTION.

The Division for the Social and International Relations of Science of the British Association held a Conference in London during March 20–21, 1942, to discuss problems connected with the post-war reconstruction of agriculture in Europe. Representatives of most of the occupied countries attended, and many addressed the Conference. A remarkable unanimity was evident in the diagnosis of the causes of pre-war agricultural troubles and in the formulation of the desiderata of reconstruction. All agreed that the best hopes for the future lie in the development of small-scale peasant farming concentrating primarily on livestock, fruit and vegetable production, this being a type of agriculture that would best serve to absorb the abundance of available labour, to raise national standards of living and of nutrition, and to enable European economy to play a more harmonious part than hitherto in world affairs.

In addition, there must be guidance and supervision on the international level, and to secure international agreement on the interpretation of the trusteeship principle itself the promulgation of a Colonial Charter is suggested. This need affirm only the following points:—1: Colonial dependencies are held in trust. 2: The primary aim of the trusteeship is to enable the dependencies to attain self-government as rapidly as possible. 3: The second major aim is the development of colonial territories primarily for the benefit of their own inhabitants. 4: The trusteeship is exercised jointly by all countries included in the international organization, but delegated so far as administrative responsibilities go to Powers with colonial experience. 5: No inherent or permanent inequality exists between races or peoples, and equal status and equal opportunity for all is a goal to be realized as speedily as possible. 6: All nations adhering to the international organization shall have equality of opportunity in the Colonies, subject only to the need for maintaining efficient administration.

The methods to be employed in furthering the general economic aim, however, must confirm to three general principles. Each area should earn as much as possible towards building up its own essential services. Secondly, the maintenance of a proper standard of living should never be left at the mercy of local commercial interests or of the stresses and strains of world economic forces; a basic minimum standard should be guaranteed, however long it may be before the area can be developed to become self-supporting. Thirdly, all external commercial enterprise must operate to the benefit of the local population. —H.W.J.

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